

## Introduction

The worldwide film demand is steadily growing. Growth in biaxially-oriented films for the packaging industry is especially strong. Biaxially-oriented films can be divided into two categories:

- Commodity films, which need to be produced as cost-efficiently as possible due to strong price pressure from the market.
- Specialty films, where a higher price is possible, however this is usually related to higher demands in technology and therefore also higher production costs.

## Application

There is a clear trend in specialty film production to multi-layer film types, where more and more co-rotating twin screw extruders are utilized. This enables film manufacturers to simultaneously feed a large variety of additives directly into the extruding process, increasing flexibility and reducing production costs. This is very beneficial in the production of multi-layer high barrier films, balanced shrink films, etc.

## Typical Process

The production of biaxially-oriented PP, PET, PS, PA, etc. film is a continuous process. In most cases it is a co-extrusion process, where up to 6 single and/or twin screw extruders are involved. Usually the base polymer and additives are fed via a continuously operating loss-in-weight feeder into the single screw extruder. A further cost efficient alternative is gravimetric feeding of additive powder directly into a twin screw extruder for optimal dispersion. The melt then passes directly inline via the usual process for cast film, then transfers to longitudinal and transverse stretching elements. The performance and short term accuracy of the gravimetric feeders is key in this process. This concept gives the producer high flexibility and high quality of the end product, as well as substantial cost savings.

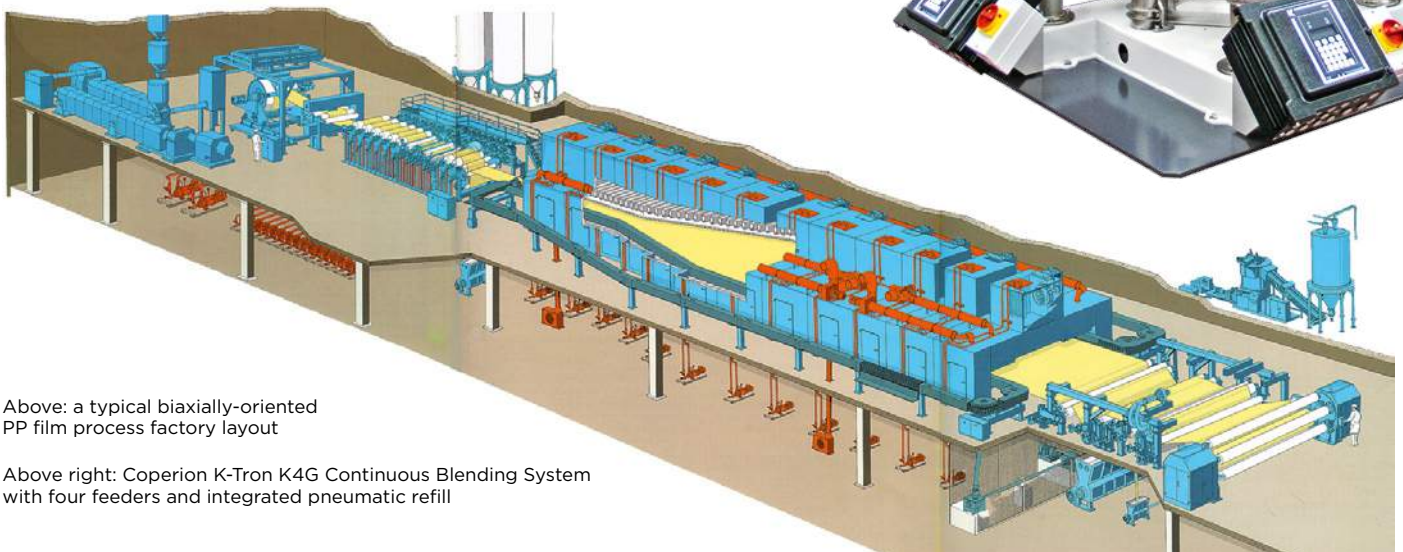
When the feeders deliver the desired massflow with an accuracy of  $\pm 0.5\%$  at 2 sigma with a sample time of 5 seconds, the pressure changes at the extruder outlet are minimal, which results in the smooth operation of the film line.

## Ingredients

Depending on the size of the film line and how many layers are involved, the typical flow ranges are as follows:

- PP-Pellets  
100 - 20'000 dm<sup>3</sup>/hr  
3.5 - 706 ft<sup>3</sup>/hr
- Masterbatch Pellets  
5 - 500 dm<sup>3</sup>/hr  
0.18 - 18 ft<sup>3</sup>/hr
- Rework (edge trims)  
10 - 5'000 dm<sup>3</sup>/hr  
0.35 - 180 ft<sup>3</sup>/hr
- PET Chips  
0 - 5'000 dm<sup>3</sup>/hr  
0.35 - 180 ft<sup>3</sup>/hr
- Additive powder  
1 - 500 dm<sup>3</sup>/hr  
0.04 - 18 ft<sup>3</sup>/hr

The desired accuracy is typically  $\pm 0.5-1\%$  at 2 sigma for the base resin and  $\pm 0.2-0.5\%$  at 2 sigma for the additives.



Above: a typical biaxially-oriented PP film process factory layout

Above right: Coperion K-Tron K4G Continuous Blending System with four feeders and integrated pneumatic refill

# Biaxially-Oriented Film Production

## Feeding System

For PP/PE base resin pellets and masterbatch pellets, the flexible K4G Continuous Blender can be easily adapted to the characteristics of the bulk material and required feed rates. The K4G is designed for on-line blending of up to six components at low to medium rates. The modular K4G design also allows pneumatic conveyors to be directly integrated into the K4G stand to refill the feeders.

A variety of Coperion K-Tron screw feeders are available for use in the K4G system, as well as the new Bulk Solids Pump (BSP) feeders. The BSP's outstanding feeding performance makes it

ideal for a uniform and pulse-free material flow.

Coperion K-Tron's K4G systems are available in 1-, 4-, and 6-ingredient versions, specially designed to be mounted directly on the extruder in a highly compact configuration. To facilitate cleaning or material changeover, each K4G feeder easily swings out providing full, unobstructed access.

For additive powders, twin screw feeders such as a K-ML-KT20 or K2-ML-T35 can handle most free-flowing to difficult materials (e.g. sticky, bridge-building).

For PET-chips and rework, which in most cases has an ir-

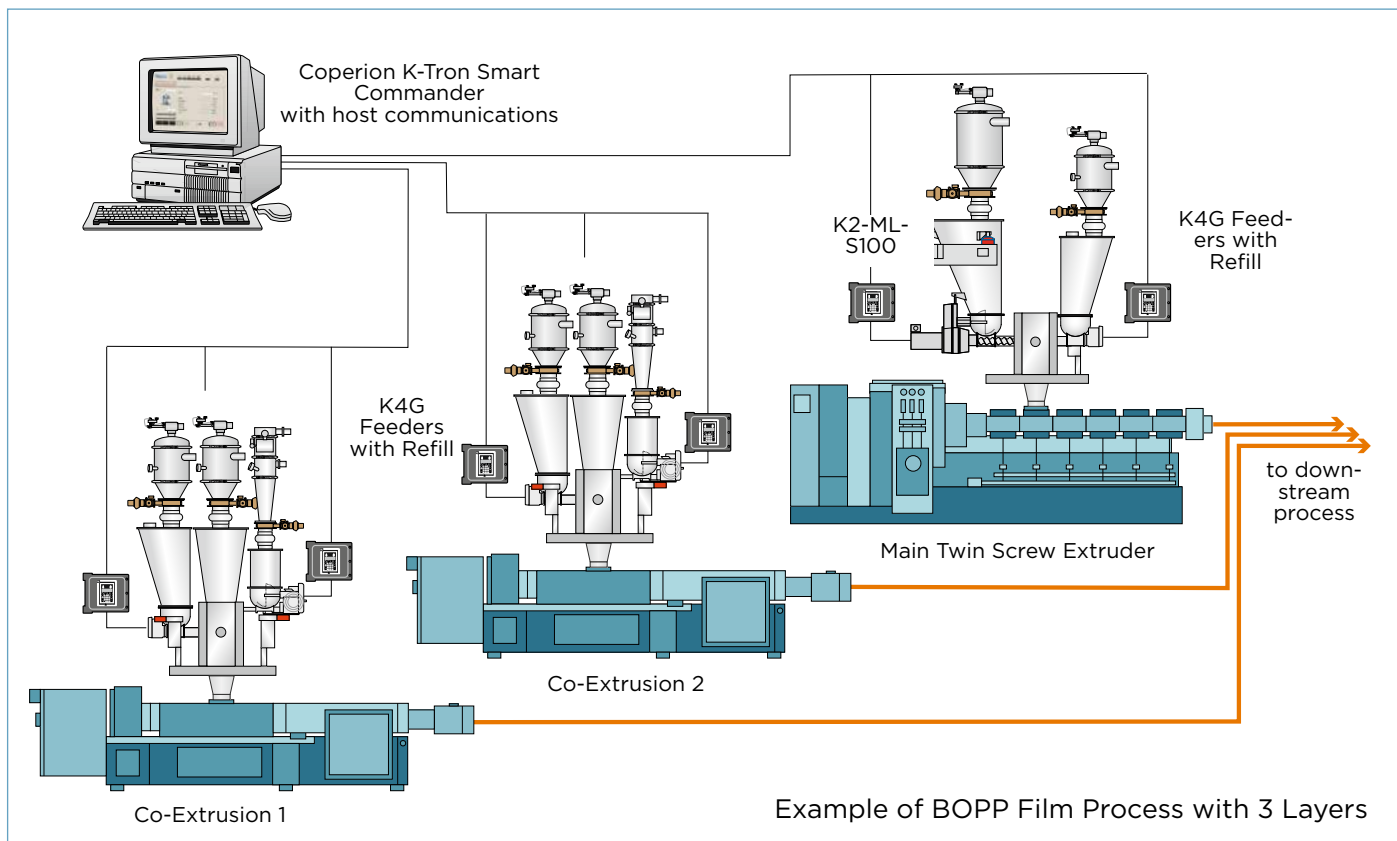
regular particle shape, a single screw loss-in-weight feeder such as a K2-ML-S60, K2-ML-S100 or KML-S500 is generally the right choice for the job. As an alternative, a Smart Weight Belt Feeder such as the SWB-300, with a S100 or S500 pre-feeder, could be utilized.

To maintain a steady flow above the single screw extruder, a continuous level monitoring device makes sure that the feeder throughput is automatically adjusted according to the material consumption of the extruder while a constant ratio of the individual ingredients is guaranteed.

## Coperion K-Tron Advantages

Coperion K-Tron's K4G continuous blending systems with integrated refill guarantee high short term accuracy with a high setpoint turndown.

Coperion K-Tron's advanced Smart Force Transducer (SFT) digital weighing technology offers outstanding short-term accuracy. High resolution weighing and powerful on board digital signal processing ensure precision feeding even at short intervals or in vibration-prone plant environments.



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